

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF NEW YORK

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JOHN KOGUT,

Plaintiff,

-against-

MEMORANDUM & ORDER
06-CV-6695(JS)(WDW)
(LEAD CASE)

THE COUNTY OF NASSAU, POLICE
COMMISSIONER DONALD KANE, POLICE
COMMISSIONER WILLIAM J. WILLETT (2005),
POLICE COMMISSIONER JAMES LAWRENCE,
DETECTIVE SEAN SPILLANE (HEAD OF HOMICIDE
1985), DETECTIVE DENNIS FARRELL (HEAD OF
HOMICIDE 2005), CAROLANN HESSEMAN, AS
EXECUTRIX FOR THE ESTATE OF JOSEPH VOLPE,
DETECTIVE ROBERT DEMPSEY, DETECTIVE ALBERT
MARTINO, DETECTIVE WAYNE BIRDSALL,
DETECTIVE MILTON G. GRUBER, DETECTIVE
CHARLES FRAAS, DETECTIVE FRANK SIRIANNI,
DETECTIVE HARRY WALTMAN, P.O. MICHAEL
CONNAUGHTON, P.O. WILLIAM DIEHL, and
JOHN DOES 1-5,

Defendants.

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JOHN RESTIVO, DENNIS HALSTEAD,
MELISSA LULLO, JASON HALSTEAD,
HEATHER HALSTEAD, and TAYLOR
HALSTEAD,

Plaintiffs,

06-CV-6720(JS)(WDW)
(MEMBER CASE)

- against -

NASSAU COUNTY, CAROLANN HESSMAN, AS
EXECUTRIX FOR THE ESTATE OF JOSEPH VOLPE,
in his individual capacity, ROBERT DEMPSEY,
in his individual capacity, FRANK SIRIANNI,
in his individual capacity, MILTON GRUBER,
in his individual capacity, HARRY WALTMAN
in his individual capacity, ALBERT MARTINO,
in his individual capacity, CHARLIE FRAAS,
in his individual capacity, THOMAS ALLEN
in his individual capacity, RICHARD BRUSA,
in his individual capacity, VINCENT DONNELLY,

in his individual capacity, MICHAEL
CONNAUGHTON, in his individual capacity,
WAYNE BIRDSALL, in his individual capacity,
WILLIAM DIEHL, in his individual capacity,
JACK SHARKEY, in his individual capacity,
DANIEL PERRINO, in his individual capacity,
ANTHONY KOZIER, in his individual capacity,
Detective Sergeant CAMPBELL, (Shield #48),
in his individual capacity, SEAN SPILLANE,
in his individual capacity, RICHARD ROE
SUPERVISORS #1-10, in their individual
capacities,

Defendants.

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SEYBERT, District Judge:

This Memorandum and Order addresses only Defendants' motion to exclude Plaintiffs' hair experts and Plaintiffs' motion to exclude Defendants' statistician. For the reasons that follow, Defendants' motion (Docket Entry 205) is DENIED except to the extent discussed below, and Plaintiffs' motion (Docket Entry 204) is GRANTED.

BACKGROUND

These Daubert motions principally concern the phenomenon that the Court will refer to as "post-mortem root banding" ("PMRB"). The Court will discuss PMRB and its

¹ Michael Ferguson, Esq. of the Nassau County Attorney's Office has participated in various proceedings in connection with this case. Mr. Ferguson is directed to file a notice of appearance forthwith.

relevance in detail, but it first turns to the crime and prosecution underlying this wrongful conviction case.

I. The Fusco Homicide

On November 10, 1984, Theresa Fusco disappeared after leaving work at approximately 9:50 p.m. Her nude body was discovered five weeks later in a wooded area on Long Island, New York. In 1986, Plaintiffs John Restivo, Dennis Halstead, and John Kogut were tried and convicted of Fusco's rape and murder. (See generally Pls. Opp. 2.)²

The only forensic evidence linking Restivo, Halstead, or Kogut to the Fusco Homicide at their 1986 criminal trials were two "questioned" hairs (the "Q8 hairs") that Nassau County Police Department ("NCPD") investigators purportedly recovered during a search of Restivo's blue van on March 26, 1985, almost five months after the murder. An NCPD analyst, Detective Charles Fraas, testified that the Q8 hairs were consistent with "known" hairs that were collected during Fusco's autopsy. (See

² There are two sets of motion papers under consideration here. Citations to "Defs. Br. __;" "Pls. Opp. __;" and "Defs. Reply __" refer to Defendants' motion to exclude Plaintiffs' experts, Plaintiffs' opposition to that motion, and Defendants' reply, respectively. Citations to "Pls. Br. __;" "Defs. Opp. __;" and "Pls. Reply __" refer to Plaintiffs' motion to exclude Defendants' expert, Defendants' opposition to that motion, and Plaintiffs' reply, respectively.

generally Pls. Opp. 2.) At Restivo and Halstead's 1986 trial, prosecutors argued that the presence of the Q8 hairs in Restivo's van proved that Restivo, Halstead, and Kogut used the van to abduct Fusco, rape her, and then, after strangling her in a cemetery, dump her body in the woods near the railroad tracks in Lynbrook--all within a span of a few hours. All three hair experts at that trial--Fraas and hair microscopist Nicholas Petraco for the prosecution and Peter De Forest for the defense--testified that they observed PMRB in the Q8 hairs.

DNA testing eventually excluded Restivo, Halstead, and Kogut as the source of the semen that was collected from Fusco's body, and all three men had their 1986 convictions vacated. Plaintiff Kogut was re-tried in 2005. At the re-trial, prosecutors offered DNA evidence matching the Q8 hairs and a third hair also ostensibly collected from Restivo's van (the "Q4 hair" and, together with the Q8 hairs, the "Q hairs") with known hairs collected during the autopsy. After considering evidence related to PMRB, Judge Victor M. Ort was persuaded that the Q hairs were not actually left in Restivo's van on the night that Fusco disappeared. (See generally Pls. Opp. 3.) Judge Ort acquitted Kogut, and the indictments against Restivo and Halstead were soon dismissed. Plaintiffs brought this wrongful

conviction case shortly thereafter. (See generally Pls. Opp. 3-4.)

II. Post-Mortem Root Banding

Plaintiffs contend that PMRB evidence demonstrates that the Q hairs were in fact autopsy hairs that were planted among, or mistakenly mixed with, trace evidence collected from Restivo's van. Plaintiffs' PMRB experts--Max Houck, Nicholas Petraco (who testified for the prosecution at Halstead and Restivo's 1986 trial), and Peter De Forest--propose to testify that PMRB is the emergence of opaque, ellipsoidal bands at the roots of hairs that have been removed from bodies that have been decomposing for at least several days. In Plaintiffs' Experts'³ opinion, PMRB only develops while hairs are still attached to a decomposing body, and the banding takes several days after death to appear. This means, then, that if the Q hairs show PMRB, then they could not have come from Ms. Fusco during the short time she was alleged to have been in the van on the night she died. A more likely explanation, from Plaintiffs' perspective,

³ Because this decision addresses both Plaintiffs' three PMRB experts and Defendants' statistics expert, and because it is sometimes helpful to describe Plaintiffs' views on PMRB in generalities, the Court will occasionally refer to all three of Plaintiffs' PMRB experts as "Plaintiffs' Experts."

is that the Q hairs were taken from the autopsy table and placed with the trace evidence collected from the van.

In June, the Court held a Daubert hearing to determine whether and to what extent Plaintiffs' Experts and Defendants' statistician, Joseph Kadane, will be permitted to testify at trial. See generally Daubert v. Merrell Dow Pharms., Inc., 509 U.S. 579, 113 S. Ct. 2786, 125 L. Ed. 2d 469 (1993). The following is a summary of the proposed experts' qualifications and opinions. Other relevant evidence, either adduced at the hearing or submitted with the parties' motions, is addressed as appropriate in the discussion section.

A. Max Houck

Houck is a forensic anthropologist and trace evidence analyst. (Pls. Ex. 1, Houck Expert Report ("Houck Rpt.") at 1⁴.) Among Houck's professional and educational achievements are Bachelor's and Master's degrees in anthropology and a Ph.D. in applied chemistry. (Id.) From 1992 to 2001, he was a physical scientist in the FBI's Laboratory Division, where he was assigned to the trace evidence unit. Later, he became the

⁴ Many of the exhibits received in evidence at the Daubert hearing were duplicative of evidence attached to the parties' motions. Except as otherwise noted, the Court will refer to evidence using the designation each exhibit received at the hearing.

director of the Forensic Science Initiative (Research) at the University of West Virginia. He held this post until 2011. (Id.) At one point during his career, Houck chaired the Scientific Working Group on Materials Analysis ("SWGMAT"), which is a professional organization whose mission is to develop consensus guidelines for best practices in the forensic sciences field. (Daubert Hearing Transcript ("Hrg. Tr.") 24-25.) SWGMAT has a sub-committee dedicated to hair and fiber analysis. (Id.)

In his expert report, Houck explains that PMRB is an artifact of decomposition:

In decomposition, hairs that were actively growing . . . until the time of death go through changes in their root ends related to the decomposition of the surrounding skin and follicle. One of the phenomena observed in these former anagen or early catagen hairs [i.e., hairs in the active growing stage] is called "putrid root" or "post-mortem root banding."

(Houck Rpt. 6.) He defines PMRB as "an opaque ellipsoidal band which appears to be composed of a collection of parallel elongated air spaces near the root of a hair, appearing as a dark or blackened band in the hair shaft." (Id. (internal quotations omitted).) This definition is derived from the seminal article on PMRB, "The Morphology and Evidential Significance of Human Hair Roots," which was authored by

Plaintiffs' other two PMRB witnesses, Nicholas Petraco and Peter De Forest, as well as Charles Fraas (the detective at the Halstead/Restivo 1986 criminal trial) and another researcher. N. Petraco, C. Fraas, F.X. Callery, and P.R. De Forest, "The Morphology and Evidential Significance of Human Hair Roots," J. FORENSIC SCI. 33(1):68-76, 73 (1988).

According to Houck, "[t]he transformation of the putrid root only occurs in roots that remain in the scalp of a decomposing body; the changes do not occur if the hair is plucked (or shed) prior to death and allowed to deteriorate." (Houck Rpt. 7.) He asserts that, according to the literature on the topic, for a hair to exhibit PMRB three conditions must be met: the hair must have been (1) in the active growing phase prior to an individual's death; (2) in the skin while the body was decomposing; and (3) "in the decomposing skin for a minimum of 7 days." (Id.) Based on Houck's understanding of the prosecution's theory of the Fusco Homicide, according to which Fusco was in Restivo's van for "perhaps less than an hour," the Q hairs could not have come from Fusco on the night she disappeared. (See id. at 7-8.) Houck concludes: "Based on the known and documented scientific clinical studies on postmortem root banding relating to its timing, description, appearance,

and conditions for existence, there is no known mechanism or reasonable explanation for [PMRB] to appear in Ms. Fusco's hairs that were allegedly left in the blue van" (Id. at 8.)

B. Nicholas Petraco

Nicholas Petraco has a Bachelor's degree in analytical chemistry and a Master's degree in forensic science. Among other things, Petraco was a trace evidence analyst with the New York Police Department ("NYPD") from 1974 until 1990. In this role, he analyzed hair evidence in thousands of cases. (Pls. Ex. 15, Petraco Expert Report ("Petraco Rpt.") 2.) Since 1990, he has consulted for the NYPD's Forensic Investigation Division, where he is responsible for performing casework, training new analysts, and establishing standard operating procedures for the Department's criminalistics unit. (Id.) Among his professional and educational accomplishments, Petraco chaired SWGMAT's hair committee and, as mentioned above, co-wrote "The Morphology and Forensic Significance of Human Hair Roots," a landmark article on PMRB. (Id. at 3.)

Like Houck, Petraco believes that the Q8 hairs purportedly collected from Restivo's van could not have come from Fusco either before she died or during the brief span between her death and when her body was left in the woods.

(Petraco Rpt. 3). As to the PMRB, Petraco opined that PMRB only develops in hairs while they are attached to a decomposing body and that the banding takes at least 8 hours after death to appear. (Id. at 4-5.) On the latter point, Petraco cites two instances in which PMRB was observed in hairs 8-10 and 10-12 hours after death, respectively. According to Petraco, these are the shortest reported intervals before which PMRB has been observed. (Id. at 5.) Petraco has never seen, read, or heard about a case in which PMRB appeared less than eight hours after death. (Id.) Petraco also states that hairs do not continue to develop post-mortem banding patterns once they've been removed from a dead scalp. (Id. at 5.)

Petraco makes two other points relevant to the following discussion. First, he observed that the Q8 hairs exhibited banding patterns that are consistent with the patterns on "known" hairs collected during Fusco's autopsy. (Id. at 6.) And, because hairs do not continue to develop PMRB once they are removed from the scalp (id. at 5), it is "extremely unlikely, and probably impossible" that the Q8 hairs--if they really came from Fusco either before or shortly after she died--would exhibit PMRB consistent with degree of banding seen on the autopsy hairs taken weeks after Fusco was murdered (id. at 6).

Second, Petraco observed that the Q8 hairs were in "pristine condition" and did not exhibit any debris, mechanical damage, or breakage that one would expect from hairs that had been on the floor of a van for four months. (Id. at 6.) In contrast, other hairs collected from Restivo's van did display these types of damage. (Id.)

Petraco also concludes that the Q4 hair could not have come from Fusco while she was alive or shortly after she died. (Id. at 6-7.) He formed this opinion for reasons similar to the rationale underpinning his conclusions as to the Q8 hairs.

C. Peter De Forest

De Forest has a Bachelor's degree and a Doctorate in criminalistics. (Pls. Ex. 25, De Forest Expert Report ("De Forest Rpt.") Ex. A.) He taught criminalistics at the John Jay College of Criminal Justice for nearly forty years. (Id.) A list of his scholarly books, chapters, articles, and presentations spans sixteen pages. (Id.) Among his many other professional memberships, De Forest is an Academic Affiliate of the American Society of Crime Laboratory Directors and a charter member of the New York Society of Forensic Sciences. At one time he was the chairman of the Council on Forensic Science Education. (Id.)

In his report, De Forest explains that although scientists do not yet fully understand how and why PMRB works (De Forest Rpt. 6), "[e]xperience and research have shown that classical post-mortem root banding in scalp hairs is only observed in hairs that have been taken from anagen follicles in partially decomposed scalp tissue." (De Forest Rpt. 6.) He observes that PMRB "is a recognized phenomenon in the scientific community of forensic hair examiners," and he states that he has kept current on develops concerning PMRB since he became involved in the case in 1986. (Id. at 7.)

Like Houck and Petraco, De Forest doesn't think that the Q8 hairs were left behind by Fusco on the night she was abducted. (Id. at 8.) The Q8 hairs exhibited PMRB, which mean that the hairs "had come from a decomposing body and had not been in the van interior environment for any period of time even approaching that of the other hairs" that had been collected from the van. (Id. at 8.) On the timing point, De Forest suggests that microbial activity may be to blame for PMRB and that the most vulnerable sections of hair (the least keratinized) enjoy the greatest protection from microbial attack (because they are under the scalp surface). (Id. at 7.) At the hearing, he elaborated on this idea, explaining that the

juxtaposition between increased vulnerability (less keratinization) and decreased microbial access as one moves along the shaft of the hair toward the root may explain PMRB's spindle or ellipsoidal shape. (Hrg. Tr. 518, 542.)

De Forest also examined "known" hairs from Fusco's autopsy and reached the following conclusion:

What is very clear is that the degree of [PMRB] observed and documented in the Q8 hairs is similar to the greatest degree of [PMRB] observed among the known hairs taken at autopsy. It is my opinion to a reasonable degree of scientific certainty that the Q8 hairs exhibiting [PMRB] came from the sample of known hairs taken at the autopsy of the homicide victim, Theresa Fusco.

(De Forest Rpt. 8.) He also concluded that the Q4 hair "exhibited post-mortem root banding beyond a reasonable scientific certainty." (Id.)

D. Joseph Kadane

The only defense expert at issue in this motion is Joseph Kadane, a statistician. He has a Ph.D. in statistics and he is a professor emeritus of statistics at Carnegie Mellon University. (Defs. Ex. L, Kadane Expert Report ("Kadane Rpt.") 1.) Although he has never studied human hair, he has previously offered expert statistics testimony. (Id.)

Defendants engaged Kadane to opine on two related questions: first, the extent to which PMRB can be reliably distinguished from pre-mortem root banding and whether the Q hairs exhibited pre- or post-mortem banding; and second, whether science can reliably ascertain the length of time since a banded hair was removed from a body. (Id. at 3.) On the first question, he refers to a study by a graduate student named Alison Domzalski that tested whether hairs from living subjects would develop root banding if they were exposed to various environmental conditions including, for example, being buried in soil. (Alison Clare Domzalski, "The Effects of Environmental Exposure on Human Scalp Hair Root Morphology" (February 2004) (the "Domzalski Paper").) Domzalski found that certain hairs did develop a type of root banding after being exposed to the elements, and she cautioned that this banding "could be confused" with PMRB. (Id. at 49) She noted, however, that the environmental banding appeared nearer to the hair root than PMRB does. (See id.) The parties dispute whether PMRB can be reliably distinguished from environmental root banding, but in Kadane's opinion, Domzalski's study shows that with respect to the evidence in this case:

[I]t is not unreasonable to suppose that the Q-hairs were also exposed to dirt in the van

in which they were found. Since the mechanism(s) that lead to root banding is unknown, we are not in a position to determine whether the Q-hairs are pre- or post-mortem. Neither of these can be excluded.

(Kadane Rpt. 11.)

On the second question, whether an examiner can tell the amount of time since a banded hair was removed from a scalp, Kadane suggests the issue is not nearly as clear-cut as Plaintiffs' Experts make it seem. Referring to Petraco's assertion that, in the hundreds of cases he has reviewed, he has not seen or read about banding appearing earlier than a day or two after death (other than the two cases where banding apparently developed within 12 hours), Kadane opines that this claim fails to account for crime scene and autopsy delays. (Kadane Rpt. 12.) In other words, an examiner can't observe whether PMRB appears shortly after death because the body won't be autopsied until significantly after death. (See id.)

Kadane's report concludes:

I find that to a high degree of scientific certainty, Dr. DeForest [sic] believes that he can distinguish reliably between postmortem hair banding and premortem (or environmental) hair banding. However, there are no validation studies confirming that he or anyone else can do this, and no published

experiments on the subject. We have only subjective belief and unsupported speculation.

(Kadane Rpt. 14.)

Kadane supplemented his report after he had reviewed Plaintiffs' Experts' findings. He concluded that report as follows:

The claim that root banding of human hairs must be postmortem is such an example [of a probabilistic claim made without statistical evidence]. Msrs. DeForest [sic], Houck and Petraco are saying with probability one that root banding must be postmortem. They have no statistical foundation for that opinion.

(Docket Entry 209-3 at 5.)

DISCUSSION

Upon careful consideration of the evidence at the Daubert hearing and the parties' arguments, the Court concludes that Plaintiffs' Experts may offer their opinions on PMRB consistent with the limitation discussed in Section II, below. Defendants' expert, Dr. Kadane, may not testify.

In the discussion that follows, the Court discusses the standard for admitting expert evidence and then applies it first to Plaintiffs' Experts and then to Dr. Kadane.

I. Legal Standard

Federal Rule of Evidence 702 is the starting point for assessing whether scientific or technical experts may testify at trial. Rule 702 provides that:

A witness who is qualified as an expert by knowledge, skill, experience, training, or education may testify in the form of an opinion or otherwise if:

(a) the expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue;

(b) the testimony is based on sufficient facts or data;

(c) the testimony is the product of reliable principles and methods; and

(d) the expert has reliably applied the principles and methods to the facts of the case.

FED. R. EVID. 702. District courts are the "gate-keepers" of expert evidence, and they must make an initial determination whether experts are qualified and whether their testimony is both relevant and reliable. See Amorgianos v. Nat'l R.R. Passenger Corp., 303 F.3d 256, 264 (2d Cir. 2002). Expert evidence is relevant if it tends to make any fact of consequence to the litigation more or less probable. Id. at 265; see also FED. R. EVID. 401. Whether an expert's testimony is sufficiently reliable may be a more nuanced question. In answering it,

courts undertake "a preliminary assessment of whether the reasoning or methodology underlying the testimony is scientifically valid and of whether that reasoning or methodology properly can be applied to the facts in issue." Daubert, 509 U.S. at 592-93. Reliability is treated in depth in Section II, below.

The proponent of an expert's testimony has the burden of satisfying the admissibility requirements by a preponderance of the evidence. E.g., United States v. Williams, 506 F.3d 151, 160 (2d Cir. 2007). The decision whether to admit or exclude a proposed expert's testimony is committed to the Court's broad discretion. E.g., Amorgianos, 303 F.3d at 264. District courts should generally exclude expert testimony "if it is speculative or conjectural or based on assumptions that are 'so unrealistic and contradictory as to suggest bad faith' or to be in essence 'an apples and oranges comparison.'" Zerega Ave. Realty Corp. v. Hornbeck Offshore Transp., L.L.C., 571 F.3d 206, 214 (2d Cir. 2009) (citing Boucher v. U.S. Suzuki Motor Corp., 73 F.3d 18, 21 (2d Cir. 1996)). "[O]ther contentions that the assumptions are unfounded go to the weight, not the admissibility, of the testimony." Id. (quoting Boucher, 73 F.3d at 212) (alteration in Boucher).

II. Plaintiffs' Experts

As discussed in this section, Plaintiffs' Experts may testify provided that their opinions on timing and on the ultimate issue of whether the Q hairs were left in Restivo's van on the night of the crime are not offered with any degree of "scientific certainty." At the outset, the Court has no trouble finding that Plaintiffs' Experts are qualified to testify about their experience in the field of forensic science. They each have a wealth of educational and professional experience and, judging by their professional associations, among other things, they are well-regarded in their field. See, e.g., Derienzo v. Trek Bicycle Corp., 376 F. Supp. 2d 537, 557 (S.D.N.Y. 2005). Whether their testimony is helpful is a similarly easy question: Plaintiffs' Experts' opinions are relevant to whether police found the Q hairs in Restivo's van or planted them there--a critical question in this case. See, e.g., Amorgianos, 303 F.3d at 265. Whether Plaintiffs' Experts' opinions are reliable and "fit" with the facts of this case merits a deeper discussion. See Katt v. City of N.Y., 151 F. Supp. 2d 313, 356 (S.D.N.Y. 2001) ("Daubert requires, more, however, than a sterling resume to permit opinion testimony by a professed expert.").

A. Are Plaintiffs' Experts' Opinions Scientifically Valid?

As mentioned already, to be admissible under Rule 702, expert testimony must be "based on sufficient facts or data" and the "product of reliable principles and methods," and the expert has to have had "reliably applied the principles and methods to the facts of the case." FED. R. EVID. 702. In Daubert, the Supreme Court set forth criteria to help courts gauge the reliability of purported scientific evidence. See 509 U.S. at 590. These are: whether a theory or technique (1) "can be (and has been) tested;" (2) "has been subjected to peer review and publication;" (3) has an acceptable rate of error; (4) is guided by accepted professional standards; and (5) is generally accepted within the relevant professional community. Id. at 593-94. Although these factors are not a definitive checklist, id. at 592, they are useful in evaluating whether an expert's scientific testimony is valid, see id. at 590.

Plaintiffs argue that their experts' testimony is admissible under either Daubert or the Supreme Court's holding in Kumho Tire Co. v. Carmichael, which extended district courts' gate-keeping function beyond "scientific" evidence to "technical, or other specialized knowledge." See 526 U.S. 137, 147, 119 S. Ct. 1167, 1174, 143 L. Ed. 2d 238 (1999). The Court

rejects this argument to the extent that it means the Court should evaluate Plaintiffs' Experts' opinions without considering the criteria the Supreme Court has identified for assessing whether an opinion meets scientific muster. Daubert teaches that "in order to qualify as 'scientific knowledge,' an inference or assertion must be derived by the scientific method." 509 U.S. at 590. Houck's and De Forest's opinions are grounded in the language of scientific certainty (see Houck Rpt. 8 (Based on the known and documented scientific"); De Forest Rpt. 8 ("It is my opinion to a reasonable degree of scientific certainty"), and it would be inappropriate to let their testimony through the gate wholesale without testing whether their opinions are scientifically valid. See United States v. Glynn, 578 F. Supp. 2d 567, 570 (S.D.N.Y. 2008); In re Ephedra Prods. Liab. Litig., 393 F. Supp. 2d 181, 187 (S.D.N.Y. 2005).

The idea that PMRB takes several days to develop (and thus that it could not have developed in the short time Ms. Fusco was alleged to be in Restivo's van) has not yet been established by scientific standards of proof. See In re Ephedra, 393 F. Supp. 2d at 186. The Court reaches this conclusion for several related reasons. First, although the

theory can be tested, it hasn't been. See, e.g., Williams, 506 F.3d at 160 (citing Daubert, 509 U.S. at 593-94). Houck highlighted some of the ethical and logistical problems associated with testing the theory on human subjects (see Hrg. Tr. 110), but a valid study does not necessarily depend on human cadavers (see Kadane Rpt. 5). The Court recognizes that this cuts both ways; if a proposition is falsifiable, then a party challenging the proposition is free to design an experiment disproving it. If this was the only shortcoming in Plaintiffs' timing theory, the Court may have been inclined to let it through. But the Court has additional concerns.

Second, while Houck, Petraco, and De Forest agree that PMRB takes days, not hours, to develop, this hypothesis is not firmly grounded in the little academic literature or studies that exist on the topic. Houck believes PMRB develops within "days" (Hrg. Tr. 173) and that if PMRB was observed in hairs from someone who had been dead less than a day it would be a "significant finding" (id. at 143). Petraco thinks PMRB typically needs two or three days to appear. (Id. at 428-29.) And De Forest says that three days is the "reasonable lower limit" of time needed for PMRB to appear. (Id. at 646.) The written work on the topic is not nearly as uniform, however, and

the value of the few studies that have been done is limited by small sample sizes or other issues. See Kelley v. Am. Heyer-Schulte Corp., 957 F. Supp. 873, 880 n.8 (W.D. Tex. 1997) ("Adequacy of a sample size is an important consideration in assessing the validity of a study"); see also Mastercard Int'l, Inc. v. First Nat. Bank of Omaha, Inc., No. 02-CV-3691, 2004 WL 326708, at *10 (S.D.N.Y. Feb. 23, 2004) (excluding a confusion survey due to an inadequate survey size). A non-exhaustive discussion of the hearing evidence follows.

One study, by Charles A. Lynch and Joseph A. Prahlow, suggests that PMRB may take between two days and a week to develop. (See Pls. Ex. 10, Charles A. Lynch & Joseph A. Prahlow, "Postmortem Microscopic Changes Observed at the Human Head Hair Proximal End," J. FORENSIC SCIENCE 2001:46(1), 15-20 [the "Lynch & Prahlow Study"].) Lynch and Prahlow only looked at twenty-two cases, though, a very small sample. (See Hrg. Tr. 520.)

Plaintiffs also point to a study in which researchers looked at hairs plucked from three gorilla corpses that had been found in the wild. (Pls. Ex. 11, Kathryn J. Jeffery, Kate A. Abernethy, Caroline E. G. Tutin & Michael W. Bruford, "Biological and Environmental Degradation of Gorilla Hair and

Microsatellite Amplification Success," BIOLOGICAL J. OF THE LINNEAN SOCIETY, 2007, 91, 281-294.) The researchers found that hair from a gorilla that had been dead for eighteen hours did not exhibit PMRB, hair from a gorilla that had been dead for three days exhibited some PMRB, and hair from a gorilla that had been dead for six days exhibited advanced decomposition. (Id. at 289-290.) Gorilla hair is similar to human hair (id. at 286), and therefore this study might suggest that PMRB takes longer than eighteen hours to develop. The problems with this study is, again, that no one knows how or why PMRB happens in humans and thus no one knows whether or how the process might work differently in gorillas. And, the sample size problem with this study is acute: the researchers only were able to study a single gorilla that had been dead for less than two days. (See id. at 283.)

Jamie Collier, a graduate student, also conducted research on the timing of PMRB. (See Pls. Ex. 14, Jamie Hughes Collier, "Estimating the Postmortem Interval in Forensic Cases through the Analysis of Postmortem Deterioration of the Human Head Hair," Master's Thesis, May 2005 [the "Collier Paper"].) She studied hairs from nine cadavers--plus one living subject as a control--and found that the earliest onset of PMRB was eighty-

nine days after death. (Id. at 23.) Dr. Houck could not reconcile these findings with his opinion that PMRB appears within one day to seven days after death. (Hrg. Tr. 186.) As with the other literature, this paper only considered a relative handful of cases. Also, all of the hairs were from middle-aged and older Caucasians, three of whom suffered from cancer. (Collier Paper at 29.) It's unclear whether or how PMRB acts differently across age and race, and because certain cancer treatments can affect hair follicles, it's possible that regimens that include chemotherapy or radiation might impact PMRB. (See Hrg. Tr. 186.)

There is also a graduate thesis by Barbara Wagner Collins, one of Dr. De Forest's graduate students. (Def. Ex. E, Barbara Wagner Collins, "The Effect of Temperature on Post Mortem Morphology of Human Hair Roots," Master's Thesis, June 1996 [the "Collins Paper"].) Collins' research employed two methods for determining the timing of PMRB. In the first, she took hair and scalp samples from autopsies and, keeping a part of each sample as a control, placed part of the sample in different test environments: soil, sand, or no medium at either four or twenty degrees Celsius (room temperature). (Id. at 12.) She observed that the scalp hair samples at room temperature

began to develop PMRB after twenty-four hours. (Id. at 15.) More pronounced banding developed by forty-eight hours, and the frequency of banding increased and then stabilized after about seventy-two hours. (Id.) The scalp hair specimens stored at four degrees Celsius never attained the degree of PMRB as the specimens stored at room temperature (id. at 16), which suggests that, like decomposition generally, PMRB development is correlated with temperature (see id. at 9 (explaining that decomposition rates depend in part on temperature)). In the second approach, Collins obtained post-mortem hairs from autopsies that had been conducted by the New York City Medical Examiner's office. (Id. at 13.) The lapse between a subject's death and the autopsy ranged from between twelve to eighty-seven hours. (Id. at 13-14.) Collins did not observe PMRB in any of these hairs, which, given the short interval between death and autopsy, she felt was consistent with the findings in her first study. (Id. at 16.) Collins' findings support Plaintiffs' position but her second approach only studied twelve samples (id. at 14), and it's unclear how many samples she studied under the first approach (although she apparently eliminated hairs from people being treated with chemotherapy and radiotherapy, (id., Abstract)).

The third reason that the Court cannot accept Plaintiffs' Experts' opinions as scientific certainty is that there have been at least two cases where PMRB has reportedly been observed much earlier than the experts would think possible. As Petraco explained in his report, in two instances in the mid-1980s, PMRB was observed between 8-12 and 10-12 hours after death, respectively. (Petraco Rpt. 5.) Obviously, if these incidents really happened, they would give lie to the idea that PMRB invariably takes days to develop. Plaintiffs attempt to cast doubt on these early sightings by suggesting that the times of death in those cases were imprecise, meaning that the bodies could have been dead longer than 12 hours. (See id. at 5.) Plaintiffs may be correct, but the point is that we just don't know. Plaintiffs fall back on the idea that these are outliers and that their experts have never seen or heard of a similar case. (See, e.g., id. ("In the 26 years I have been actively following this issue since the trial, I have never seen, read, or heard about a case of postmortem root banding occurring within less than 8 hours after death.")) On this point, though, Kadane's concerns about autopsy bias are well-taken; if forensic scientists are not in a position to find PMRB within a short time of someone's death, they will never do so.

In sum, the idea that PMRB needs multiple days to develop cannot withstand the rigors of scientific proof, and it goes too far for Plaintiffs' Experts to testify that their conclusions are sound to a "reasonable degree of scientific certainty." See Glynn, 578 F. Supp. 2d at 574 ("[T]o allow Detective Valenti, or any other ballistics examiner, to testify that he had matched a bullet or casing to a particular gun 'to a reasonable degree of ballistic certainty' would seriously mislead the jury as to the nature of the expertise involved."). That is not to say, however, that Plaintiffs' Experts' testimony is completely excluded.

B. Are Plaintiffs' Experts' Opinions Otherwise Reliable?

Under Evidence Rule 702, witnesses with "technical or other specialized knowledge" may offer their "opinions on matters where the data falls short of proving the witness's conclusion." In re Ephredra, 393 F. Supp. 2d at 188. As Judge Rakoff explained, "an art appraiser testifying about a painting's authenticity might state an opinion based in part on scientific analysis, but the ultimate conclusion would come from the witness's specialized knowledge, training and experience." Id. "Scientists, too, form professional opinions that are reasonably based on 'good science' but where the data is

insufficient for definitive scientific proof." Id. In the Court's view, at least, this is what we have here: much of what Plaintiffs' Experts have to say is grounded in sound science, and the last leap--the timing--is justified by their training and experience.

Aside from the timing issue, Plaintiffs' Experts' testimony on PMRB is supported by many of Daubert's indicia of reliability. One, there is evidence that PMRB can be distinguished from environmental banding within an acceptable rate of error. A group of FBI analysts, led by Stephen Shaw, conducted a study for which they collected 600 hairs and subjected them to a range of environmental conditions. Although these hairs exhibited signs of decomposition, they did not present PMRB. These hairs were then mixed with hairs known to have come from deceased subjects. According to the abstract of the study (whose publication is forthcoming), two hair examiners were able to distinguish post-mortem root-banded hairs from environmentally-banded hairs with 99.5% accuracy. When the two examiners double-checked each other's work, their accuracy increased to 100%. (See generally Pls. Ex. 12.) Suffice it to say, this is a tolerable error rate. See, e.g., United States v. Crisp, 324 F.3d 261, 271 (4th Cir. 2003). Further, the Shaw

study is generally in line with Alison Domzalski's results, which showed that although environmental insults produce changes to scalp hair roots, these changes should not be confused with PMRB. (See Domzalski Paper at 49 (noting that although environmental banding "could be confused" with PMRB, the environmental banding that Domzalski encountered was "very proximal to the anagen root end. This is not an accepted criterion for postmortem root banding"); Hrg. Tr. 673 (Shaw study validates Domzalski's research), 372 (environmental banding can be distinguished from PMRB).)

Two, Plaintiffs' Experts' opinions are consistent with the academic literature on the topic. (See, e.g., Pls. Ex. 10 at 19 ("Postmortem head hair proximal end microscopic changes are sufficiently specific for the experienced examiner to offer an opinion that an evidence hair may have originated from decomposing scalp tissue."); see also Pls. Ex. 6, S. Seta, H. Sato, M. Yoshino and S. Miyasaka, "Morphological Changes of Hair Root with the Time Lapsed After Death," J. OF THE FORENSIC SCI. SOC. 24:4 (July/August 1984).)

Relatedly, three, PMRB as Plaintiffs' Experts' describe it is a generally accepted phenomenon within the forensic science community. (See, e.g., Pls. Ex. 12 ("Based on

the experience of hair examiners, postmortem banding is generally accepted throughout the forensic hair community as a reliable indication of hair removal during the postmortem process."); Petraco Rpt. at 4-5 (identifying basic principles of PMRB that are "established in the forensic scientific community"); see also Hrg. Tr. 36-37 ("Q. Would it be fair to say that since the Petraco De Forest publication in 1988, that the way they defined and described [PMRB] was generally accepted in the community of hair microscopists and forensic anthropologists as the definition of [PMRB]? A. Yes." (Houck Testim.)).⁵

⁵ Moreover, the Court notes that Houck and Petraco have examined hairs both from living and dead subjects, and they have never observed PMRB in hairs from a living person. (See Hrg. Tr. 81 (Houck); id. at 346, 358 (Petraco).) Just as significant, they have never seen, heard, or read about a case where PMRB was observed in hair from a living person. (Id. at 81 (Houck); id. at 358 (Petraco).) Given their deep ties to the hair microscopy community (see, e.g., id. at 24 (Houck), id. at 302-03 (Petraco)), this suggests that such a case has never been observed. See also id. at 83-84 (Houck would expect to learn through his professional network if another microscopist were to observe PMRB in a hair plucked from a living person). Defendants' position--that Plaintiffs' view is logically flawed because Plaintiffs' Experts look at hairs only from dead people (during autopsies, for example)--is factually incorrect. Houck and Petraco have examined hairs from both living and dead people over their long and distinguished careers. (Id. at 167 (Houck); id. at 346 (Petraco).)

The issue, then, in light of their testimony on PMRB generally, is whether Plaintiffs' Experts may offer their professional opinions on the timing of PMRB. The Court concludes that they may, consistent with the limitation described above. Without repeating much of the evidence already discussed in Section II.A, the Court is convinced that although these facts do not add up to scientific proof, they supply a reasonable basis for forensic experts to conclude that PMRB is an artifact of decomposition and that, consistent with the speed at which other effects of decomposition appear on a corpse, it does not appear immediately after death. The Collins Paper, the gorilla study, the Linch & Prahlow Study (see supra 23-26), and De Forest's juxtaposition hypothesis (supra 13-14) all suggest that PMRB takes more than a few hours to develop in the scalp hairs of a dead body and thus it may be more likely than not that the Q hairs in Restivo's van did not come from Fusco on the night she died. See In re Ephedra, 393 F. Supp. 2d at 190 (applying a "more-probable-than-not" standard to scientific issues). In sum, this is not a case where the Court "finds the gap too great between the science and [Plaintiffs' Experts'] conclusions." Id. at 189; see also Kumho Tire, 526 U.S. at 156 ("[N]o one denies that an expert might draw a conclusion from a

set of observations based on extensive and specialized experience.").

Defendants' remaining objections go to the weight of Plaintiffs' Experts' testimony, not its admissibility. Plaintiffs' Experts may offer their opinions as to PMRB except that they may not testify that their views on the timing of PMRB (or any ultimate opinion that the Q hairs did not come from Fusco on the night she died) are matters of "scientific certainty." See id. at 190 (precluding expert from testifying that causality was established "to a reasonable degree of scientific certainty" but permitting testimony that a particular causality was plausible or "more-probable-than-not").

III. Defendants' Expert

Plaintiffs move to exclude Kadane's testimony, arguing that he is not qualified to opine on matters related to hair microscopy, has not reliably applied any worthwhile methodology to the facts of the case, and offers legal conclusions under the guise of scientific expertise. (See generally Pls. Br. 9-17.) The Court agrees that Kadane does not have the relevant expertise to offer a helpful opinion at trial. For expert testimony to be admissible, it must have "a reliable basis in the knowledge and experience of the relevant discipline." Kumho

Tire, 526 U.S. at 149 (alterations and quotation marks omitted). Although there is no dispute that Kadane is an accomplished statistician, it is equally beyond debate that he lacks more than a passing familiarity with hair microscopy and forensic science. His expertise is simply not useful in attempting to refute Plaintiffs' Experts' opinions about PMRB. Malletier v. Dooney & Bourke, Inc., 525 F. Supp. 2d 558, 642 (S.D.N.Y. 2007) ("An expert qualified in one subject matter does not thereby become an expert for all purposes. Testimony on subject matters unrelated to the witness's area of expertise is prohibited by Rule 702."). As Plaintiffs note, Kadane was free to conduct his own statistical analysis of PMRB but did not do so. (Pls. Br. 2).

CONCLUSION

For the foregoing reasons, Defendants' motion to exclude Plaintiffs' experts is DENIED except to the extent that the discussion above precludes Plaintiffs' Experts' from testifying to any degree of "scientific certainty." Plaintiffs' motion to exclude Defendant's statistics expert is GRANTED. Defendants' request to re-open the Daubert record (Docket Entry 289) is DENIED because the evidence to which they call the Court's attention is irrelevant. Defendants' motion to file excess pages (Docket 229) is retroactively GRANTED.

SO ORDERED.

/s/ JOANNA SEYBERT
Joanna Seybert, U.S.D.J.

Dated: August 15, 2012
Central Islip, New York